Alan F. Ciamporcero
Senior Counsel

1275 Pennsylvania Avenue, N.W.
Suite 400
Washington, DC 20004
(202) 383-6416

EX PARTE OR LATE FILED

PACIFIC TELESIS
Group

June 1, 1994

RECEIVED

JUN 1 1994

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

DOCKET FILE COPY ORIGINAL

EX PARTE

William F. Caton
Acting Secretary
Federal Communications Commission
Mail Stop 1170
1919 M Street, N.W., Room 222
Washington, D.C. 20554

Dear Mr. Caton:

Re: *Gen. Docket No. 90-314, Personal Communication Services*

In a May 18, 1994 meeting with Pacific Telesis representatives, Byron Marchant of Commissioner Barrett's office asked for more information on possible interference issues for increased PCS power levels. The attached material responds to that request. Please associate this material with the above-referenced proceeding.

We are submitting two copies of this notice in accordance with Section 1.1206(a)(1) of the Commission's Rules.

Please stamp and return the provided copy to confirm your receipt. Please contact me should you have any questions or require additional information concerning this matter.

Sincerely,

Alan F. Ciamporcero

Attachment

cc: Byron Marchant

No. of Copies rec'd 0+1
List ABCDE

PCS Power Levels and Interference

Summary

Below is the response from Pacific Bell to questions concerning recommendations for increased PCS power levels and potential interference problems. Our conclusion is that there is small interference to adjacent frequency blocks from a 2400 EIRP source. It is possible to design selective filters with relatively small bandwidths for higher PCS frequencies which eliminate potential interference from a 2400 EIRP radiated power.

Cellular systems are deployed using analog or digital technologies. Considering the proposals submitted to the Joint Technical Committee (JTC), one can conclude that future PCS implementation in the U.S. will be based on digital technologies. In order to define the interference between different PCS systems which operate in adjacent frequency spectrum, we must determine the output power of PCS transmitters vs. frequency. This requires studying the power spectral density of the modulator which is employed in digital cellular systems.

Generally, power spectral density describes null-to-null and half power bandwidth of radiated power. It also defines the percentage of radiated power inside and outside of a defined bandwidth. This can be utilized to show the compliance of a system with FCC spectrum mask which states allowed out-of-band emissions. The power spectral density of digital modulators is more efficient than analog modulators. Based band filtering which is utilized in digital modulation block is the major contribution factor. This means that base band filtering provides higher attenuation of radiated power vs. frequency. The attenuation factor is so high that for a 2400 W EIRP radiated power the level of adjacent interference inside and outside band will be low. This can be shown by two examples:

Example A: M-ary 16QAM

M-ary 16 Quadrature Amplitude Modulation(M-ary 16QAM) as a modulation scheme is employed in the ESMR technology of Nextel . Even though Nextel's system is not proposed as a PCS technology, power spectral density of M-16QAM is a good representation of an efficient digital modulator. As figure 1 shows, the power attenuation of a ESMR channel vs. the first adjacent channel (12.5 kHz) is -54 dB. Therefore, we can calculate the amount of power from a 2400 W EIRP ESMR transmitter in a 12.5 kHz frequency difference from the carrier.

2400 W EIRP => 63.8dBm

Considering -54 dB attenuation

Amount of interference in 12.5 kHz frequency difference=63.8 -54=9.8 dBm = 9.5 mW EIRP

Amount of interference in 25 kHz separation = 63.8 -70=-6.2 dBm=0.2mW EIRP

Examining the power spectral density of M-16QAM vs. FCC spectrum mask shows that the power vs. frequency characteristics of M-16QAM not only fulfills the FCC's requirements but exceeds them.

Example B: Gaussian Minimum Shift Keying (GMSK)

The modulation scheme of many proposals at JTC is based on the GMSK. Figure 2 shows the spectral density of GMSK (CCITT, Rec. 05.05). As this figure indicates, for a 600 kHz frequency difference from the carrier, the original power drops significantly. This drop is -70 dB.

GMSK achieves higher attenuation slope of power vs. frequency by utilizing a pre-modulation low pass filter with a Gaussian charactristics in conjunction with the Minimum Shift Keying (MSK) modulator. Figure 3 shows the attenuation slope of MSK vs. four curves of GMSK. Based on this figure, GMSK has the best attenuation slope for a Gaussian filter of $B_bT=0.16$. Figure 4 shows the typical power spectral density of GMSK. Using figure 4, 2400 EIRP transmitter power for frequency difference of 500 kHz will be:

2400 W EIRP => 63.8dBm

Power Attenuation for a 500 kHz frequency difference=-73 dBm

Power in a 500 kHz=63.8-73=-9.2 dBm=0.12 mW

Conclusions

The power spectral density of a digital modulation scheme is a good representation of the adjacent interference inside and outside of future PCS bands. The examples show that the interference from a 2400 EIRP radiated power in small bandwidths such as 25 kHz and 500 kHz is small. It is possible to design selective filters with bandwidths of 500 kHz in the higher frequencies of PCS. This eliminates adjacent interference from a 2400 EIRP radiated power source.

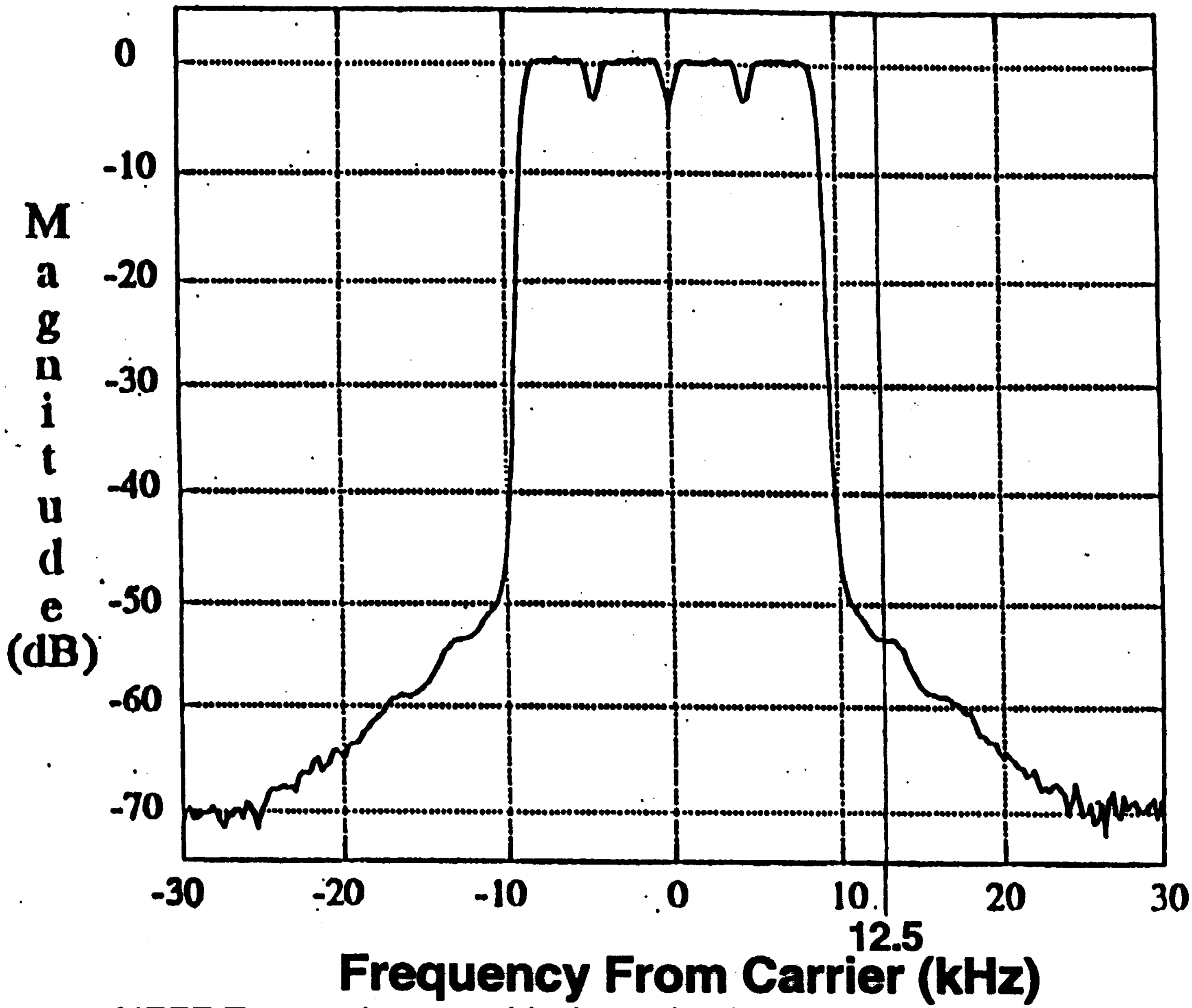


Figure 1. Courtesy of IEEE Transaction on vehicular technology

M-16QAM Spectrum

ANNEX 1: SPECTRUM CHARACTERISTICS
(spectrum due to the modulation)

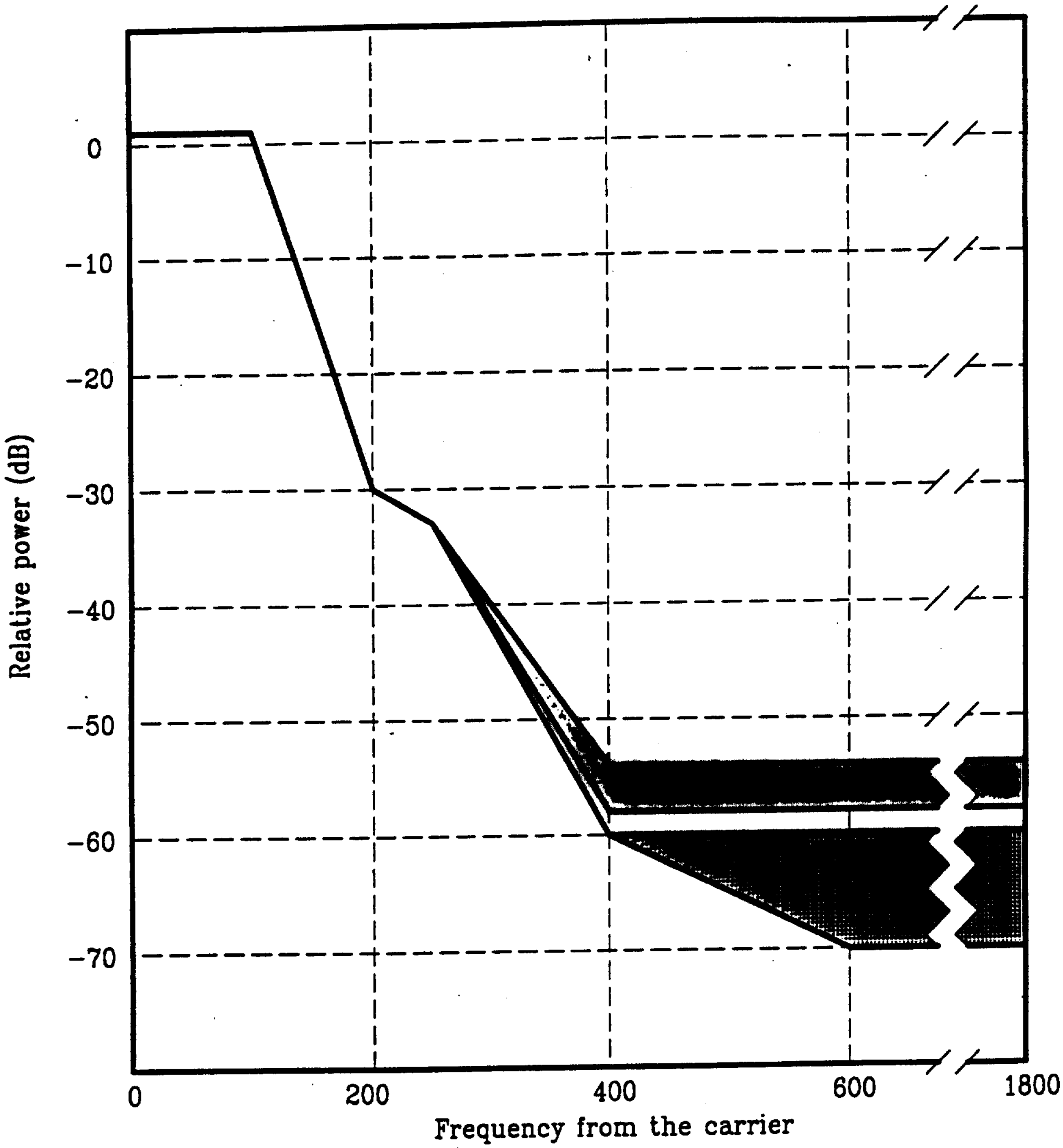


Figure 2.

Integral antenna transmitters

Antenna connector transmitters

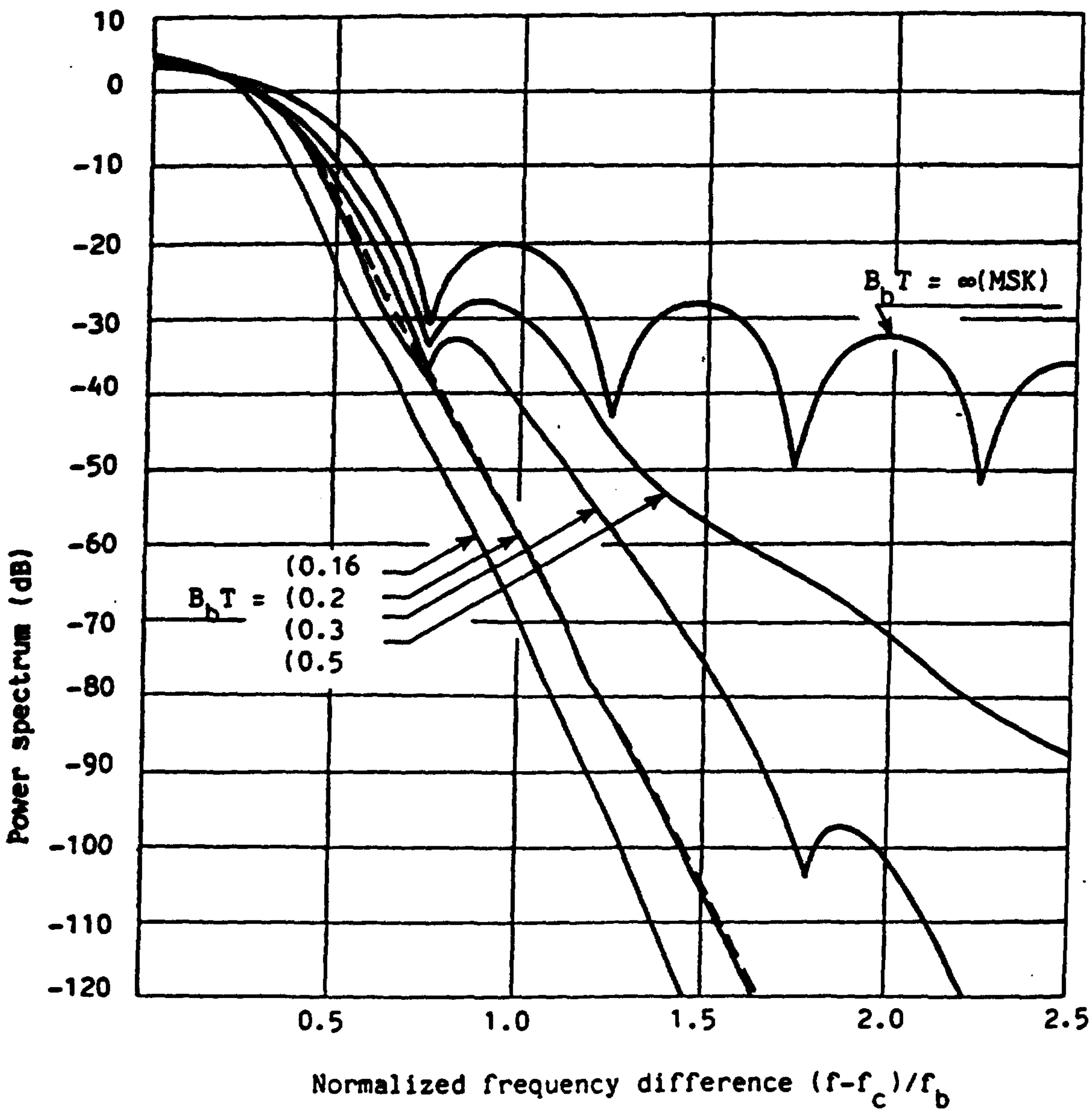
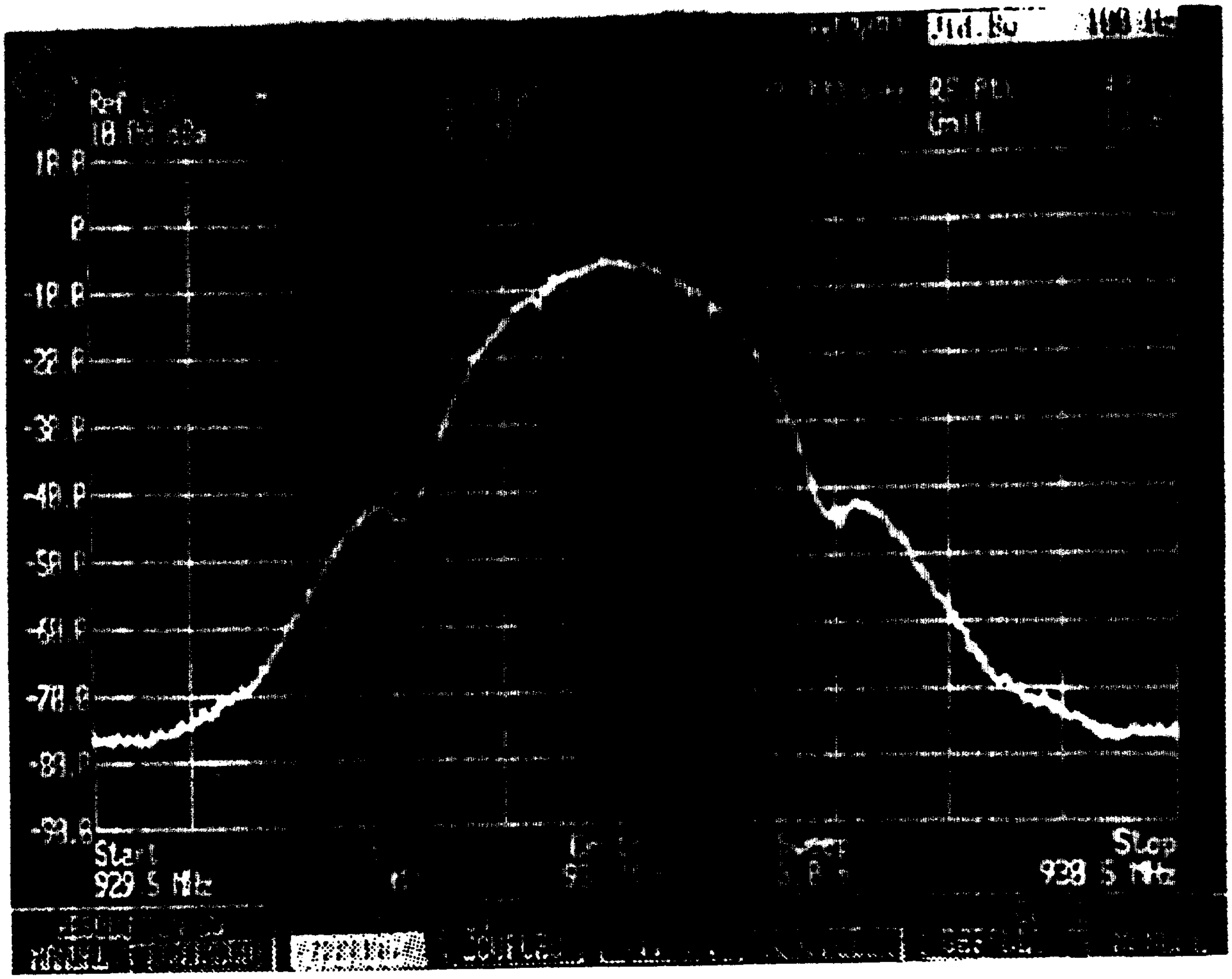


Figure 3. *Courtesy of MOBILE COMMUNICATION SYSTEMS J.D. PARSONS J.G. GARDINER



GMSK modulation spectrum

Figure 4. *Courtesy of ROHDE & SCHWARZ